Space Weather Technical Forecast

Issued on Friday, 26 May 2023 at 01:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1/R2 radio blackouts Likely. Active fluence Expected.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate over the last 24 hours**.** There are currently six numbered sunspots and one small, new and weak simple region in the northeast quadrant. AR3311 remains the largest region on the visible disc, and one of two magnetically complex regions, as AR3311 along with AR3114 contain small delta spots. The delta spot within AR3314 has recently developed, due to the merging of intermediate spots, in comparison with the apparent weakening of the delta region in AR3311. Despite their complexity these regions did not produced the largest flare of the past 24 hours, instead this was emitted from AR3312, peaking at M1.1 at 25/1446 UTC. AR3312 appears surprisingly small and simple, with a Bxi/beta classification.

A CME probably linked to the M1 flare from AR3312 may have an Earth directed component, and analysis is currently being undertaken. Otherwise no Earth-directed CMEs were observed in available coronagraph imagery, although there have been numerous far sided CME's, as a disappearing filament from the southwest quadrant around 25/1030UTC does not show evidence of a CME, it may have been re-absorbed.

Solar Wind / Geomagnetic Activity: Solar winds observed at L1 by ACE and DSCOVR have shown a fast wind regime, likely to be that from CH06/-, with the phi angle accordingly negative (towards the Sun). Solar wind speeds have been predominantly Elevated, generally between 530-580 km/s, but occasionally reached Strong levels over 600 km/s. Late in the day a slight declining trend was evident. The solar wind density persisted at below average values in single figures ppcc. The IMF was steady at or below 6nT, with a north-south component reaching a maximum of -6nT. The net result of the above solar wind measures was for Quiet to Unsettled (Kp 1-3) geomagnetic activity.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, has remained at Background levels throughout.
High energy electron flux (greater than 2MeV), as measured at GOES16, ranged from Background to occasionally High levels during the first half of the day, then increased to become mainly High thereafter, with a peak of 3826 pfu observed at 25/1550 UTC. The 24-hour integrated fluence remained above Active levels with a slight rising trend, and a value of 1.36e8 integrated pfu recorded at 26/0001UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is Likely to remain Moderate, with isolated M-class flares Likely and a Slight Chance of X-class flares. These most likely from the complex AR3311, AR3312 and AR3314. No sunspots leave the disc in the four days, while potentially new regions may rotate on from the far side. As these regions have yet to appear for analysis over the eastern limb, the potential risks of significant flares remain constant throughout the forecast period.

Solar Wind / Geomagnetic Activity: Currently there are no Earth-directed CMEs expected, although a weak CME that appears in some MOSWOC Enlil ensemble members may give some glancing influence today or tomorrow (26 or 27 May).
Solar winds expected to start at Elevated levels around 500km/s due to the continued influence of the high speed stream from large coronal hole CH06/- in the southwest quadrant. Wind speeds are forecast to decline steadily towards background levels through today, tomorrow and day 3 (26 to 28th May), although any decline may be temporarily inhibited by the possible CME glance. During day 4 (29th) a new high speed stream from CH07 is expected to become geoeffective, with speeds of 500-550 km/s possible.
Geomagnetic activity is expected to be Quiet to Unsettled (Kp 1-3) today and again day 4 (29th) with a slight chance of isolated Active (Kp 4) intervals. In-between predominantly Quiet activity is expected.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels, but there is a slight chance of reaching the S1/Minor Storm threshold should any larger flares occur.
High energy electron flux (greater than 2MeV) is expected to continue to reach High levels at the diurnal peaks, with peaks likely rising through the period. The associated electron fluence is also likely to follow a rising trend, with Active (1e8 integrated pfu) conditions now expected throughout the period.

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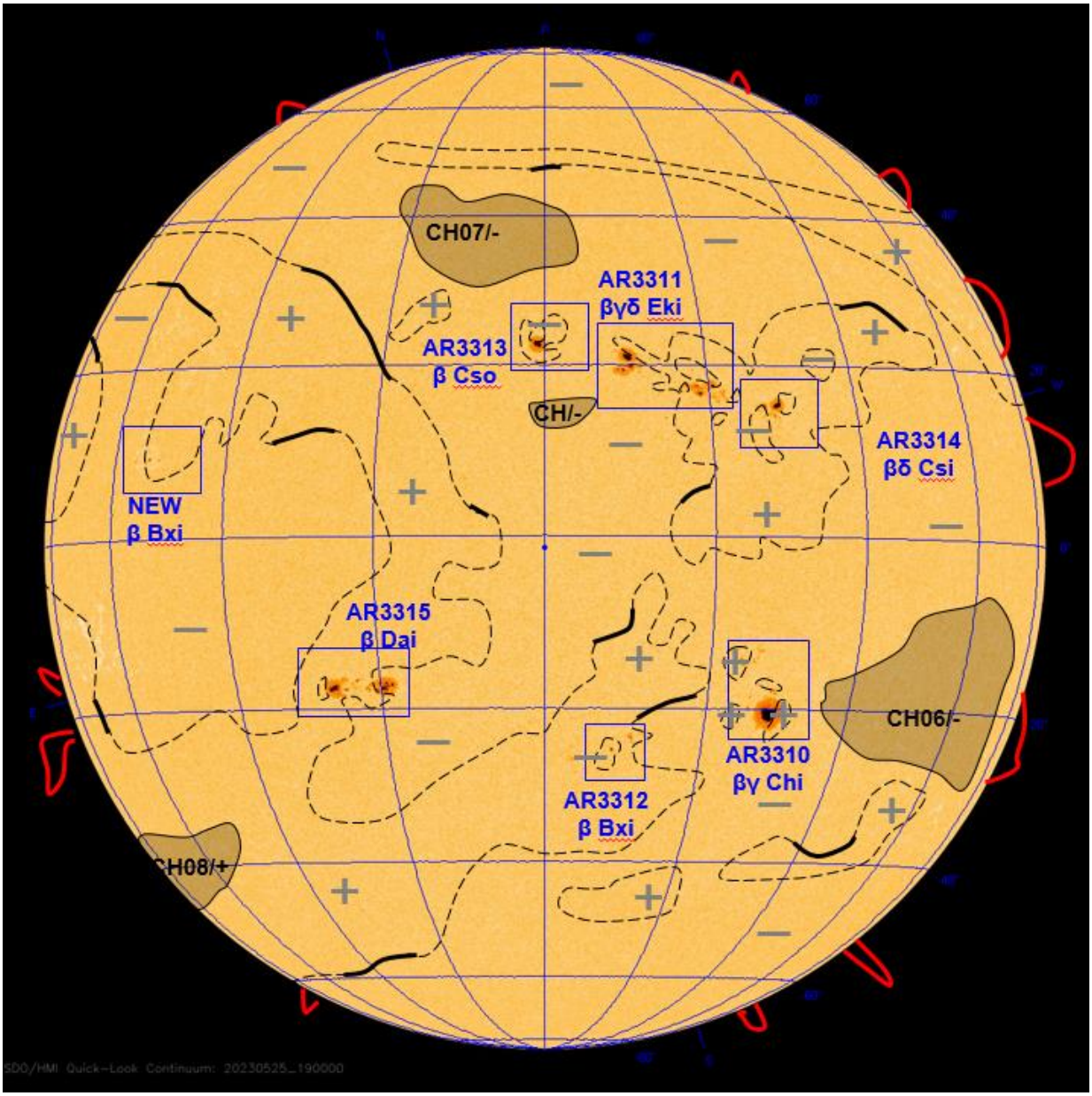
Figure 1. Solar Analysis Valid 25/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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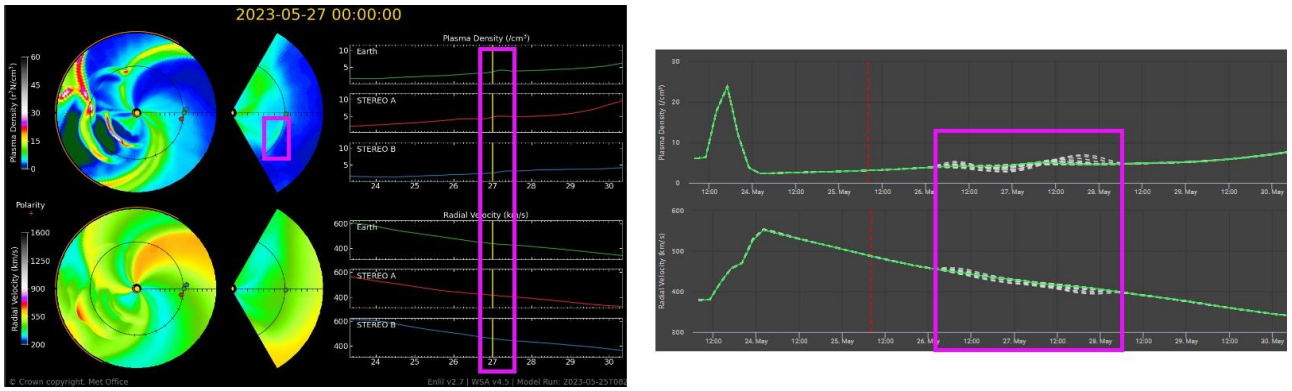
Geomagnetic Storms:

There is a very slight chance of a CME which left the Sun on 22 May glancing Earth on today or tomorrow (26 or 27 May). The MOSWOC Enlil deterministic run has this as a miss, and this is the preferred forecast. However, there is a suggestion in the ensemble of one or two narrow glances that warrant its inclusion as a mention - significant interaction is not expected. No further Earth-directed CMEs have been observed in available imagery are currently expected.
Solar winds expected to start at Elevated levels around 500km/s due to the continued influence of the high speed stream from large coronal hole CH06/- in the southwest quadrant. Wind speeds are forecast to decline steadily towards background levels through today, tomorrow and day 3 (26 to 28th May), although any decline may be temporarily inhibited by the possible CME glance. During day 4 (29th) a new high speed stream from CH07/- in the northern hemisphere is expected to become geoeffective, with speeds of around 500 km/s possible, indicated from persistence from the previous rotation.
Geomagnetic activity is expected to be Quiet to Unsettled (Kp 1-3) today and again day 4 (29th) with a slight chance of isolated Active (Kp 4) intervals. In-between predominantly Quiet activity is expected.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	1	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil and ensemble, showing very marginal influence in some members from the 22 May southeast quadrant CME.



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Radio Blackouts - X-Ray Flares:

There are currently six numbered sunspots and one small, new and weak simple region in the northeast quadrant. AR3311 in the northwest remains the largest and most complex region, with a Mt Wilson Delta spot persisting within the intermediate portion of the group, although this is gradually weakening. AR3314 appears to have developed a small delta spot, as intermediate spots have consolidated. AR3315 has continued to develop, although at a slower pace than previously, gaining a few more small intermediate spots. AR3312 continues as a relatively minor region with some arcing between this region and AR3310, to its west, that may help explain the M-class activity in the former. Finally, AR3313 was relatively unchanged in the period.
Solar activity is expected to remain Moderate, with isolated M-class flares likely and a slight chance of X-class flares. These most likely from AR3311, but also AR3312 and AR3314 due to the magnetic complexity of AR3311 and AR3314, and the history of AR3312.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES16, is at Background levels and is currently expected to remain so throughout the period.
There is a small and gradually rising risk of enhancement should any larger flares occur, as the most likely regions to produce significant flares are all currently within the western hemisphere. Therefore a Slight Chance of reaching the S1/Minor Storm threshold is maintained throughout.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	15	15	15
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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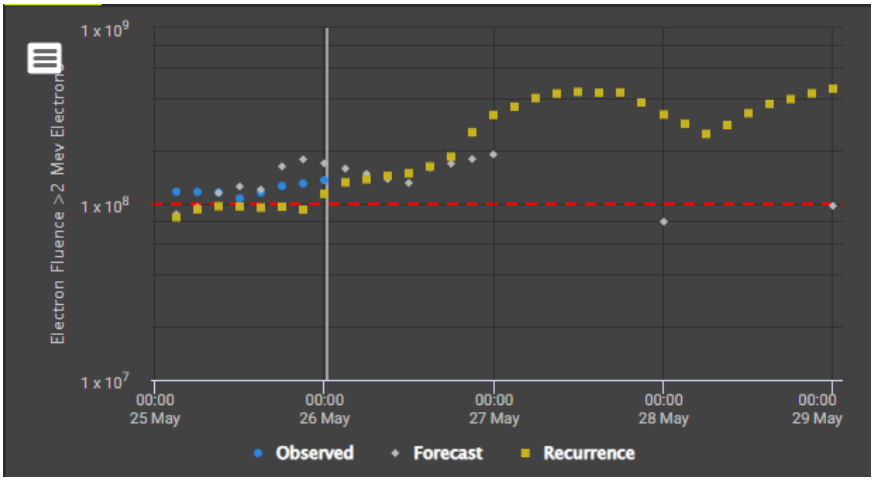
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to continue to reach High levels at the diurnal peaks, with peaks likely rising through the period. The associated electron fluence is also expected to follow a rising trend, with Active (1e8 integrated pfu) conditions now expected throughout the period.

The current MOSWOC REFM model output is viewed as initially good guidance, with an increasing trend in the fluence through today. Thereafter the decline in fluence below the Active threshold is considered unlikely to occur.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	90	90	80
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: MOSWOC REFM model.



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